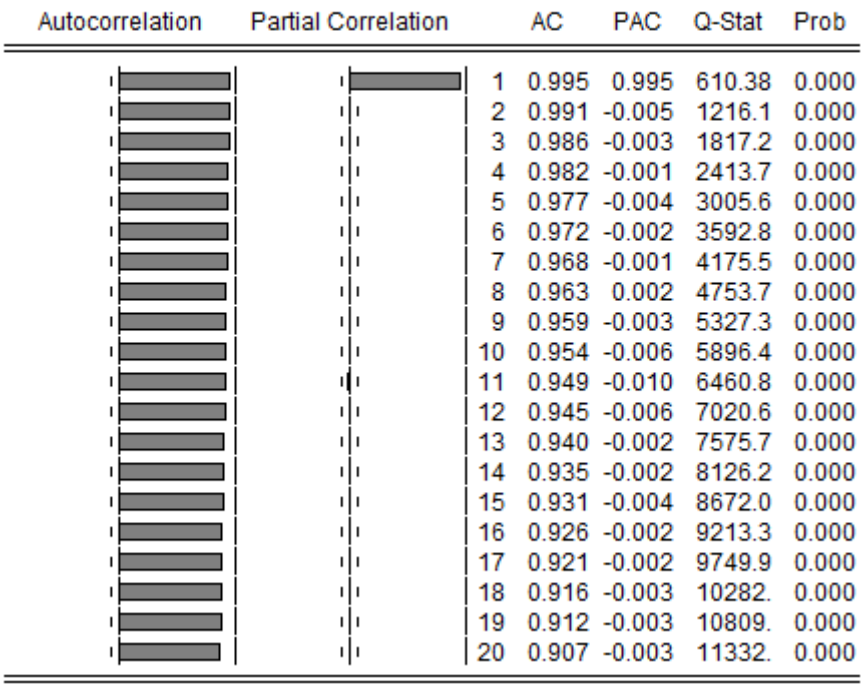
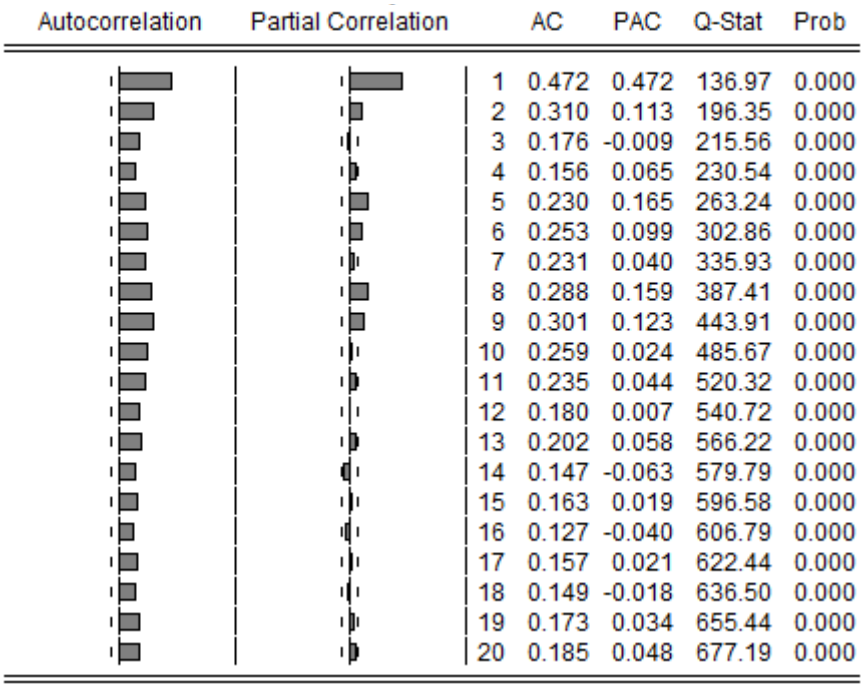
Assignment 2 – Paolo Sebastiani



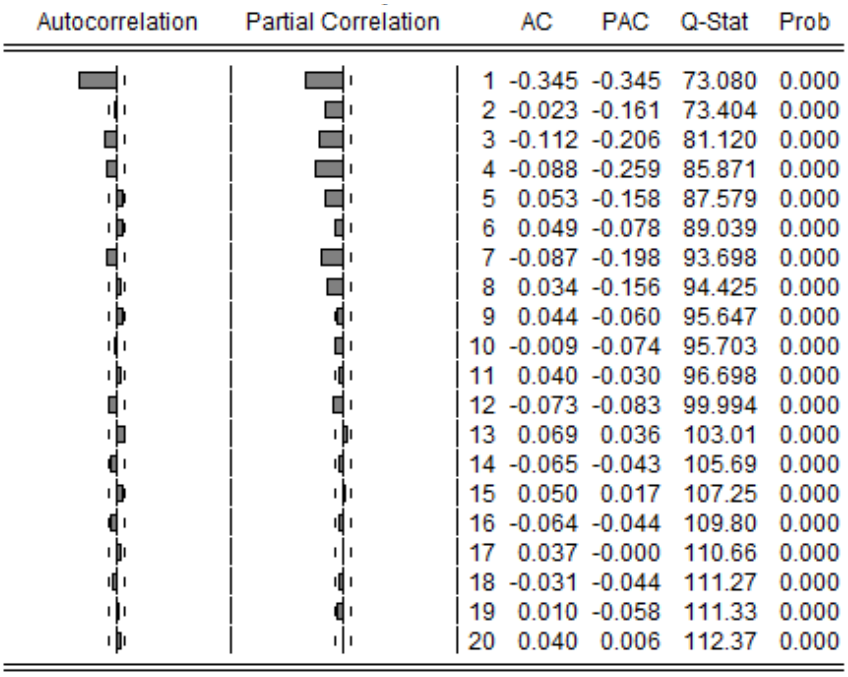
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.995	0.995	610.38	0.000
		2	0.991	-0.005	1216.1	0.000
		3	0.986	-0.003	1817.2	0.000
		4	0.982	-0.001	2413.7	0.000
		5	0.977	-0.004	3005.6	0.000
		6	0.972	-0.002	3592.8	0.000
		7	0.968	-0.001	4175.5	0.000
		8	0.963	0.002	4753.7	0.000
		9	0.959	-0.003	5327.3	0.000
		10	0.954	-0.006	5896.4	0.000
		11	0.949	-0.010	6460.8	0.000
		12	0.945	-0.006	7020.6	0.000
		13	0.940	-0.002	7575.7	0.000
		14	0.935	-0.002	8126.2	0.000
		15	0.931	-0.004	8672.0	0.000
		16	0.926	-0.002	9213.3	0.000
		17	0.921	-0.002	9749.9	0.000
		18	0.916	-0.003	10282.	0.000
		19	0.912	-0.003	10809.	0.000
		20	0.907	-0.003	11332.	0.000

CPILFESL in levels: The autocorrelation function (ACF) shows very slow decay, with values remaining close to 1 even at high lags. Therefore the series is non stationary, and a differentiation is needed.



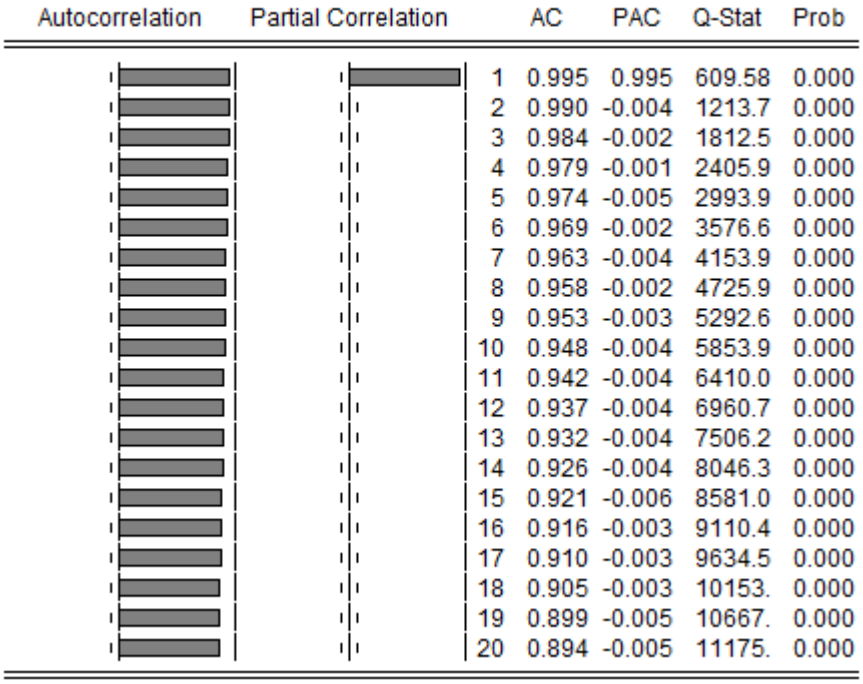
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.472	0.472	136.97	0.000
		2	0.310	0.113	196.35	0.000
		3	0.176	-0.009	215.56	0.000
		4	0.156	0.065	230.54	0.000
		5	0.230	0.165	263.24	0.000
		6	0.253	0.099	302.86	0.000
		7	0.231	0.040	335.93	0.000
		8	0.288	0.159	387.41	0.000
		9	0.301	0.123	443.91	0.000
		10	0.259	0.024	485.67	0.000
		11	0.235	0.044	520.32	0.000
		12	0.180	0.007	540.72	0.000
		13	0.202	0.058	566.22	0.000
		14	0.147	-0.063	579.79	0.000
		15	0.163	0.019	596.58	0.000
		16	0.127	-0.040	606.79	0.000
		17	0.157	0.021	622.44	0.000
		18	0.149	-0.018	636.50	0.000
		19	0.173	0.034	655.44	0.000
		20	0.185	0.048	677.19	0.000

First differences of CPILFESL: The ACF still shows a very slow decay, so probaby another differentiation is needed.



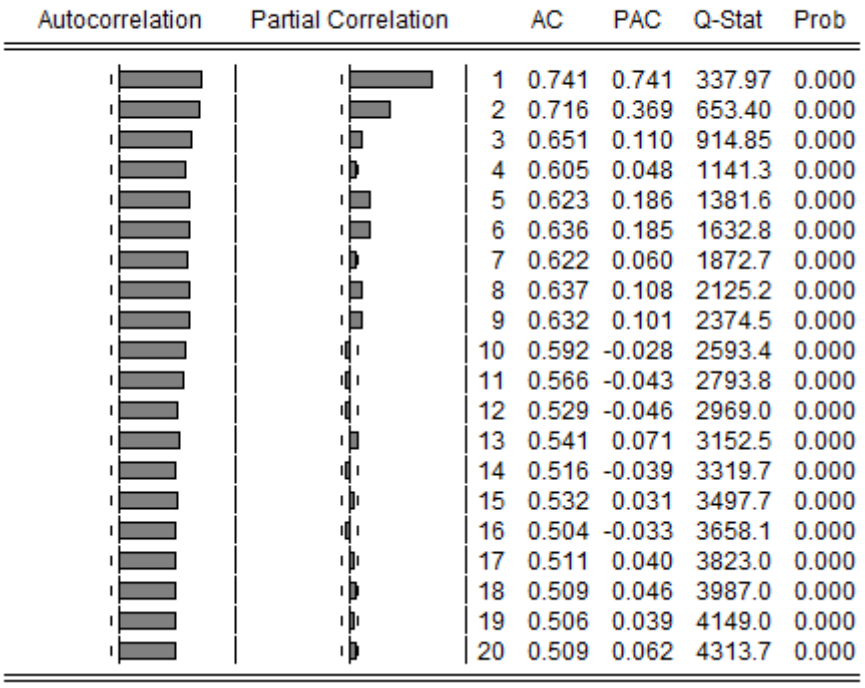
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.345	-0.345	73.080	0.000
		2	-0.023	-0.161	73.404	0.000
		3	-0.112	-0.206	81.120	0.000
		4	-0.088	-0.259	85.871	0.000
		5	0.053	-0.158	87.579	0.000
		6	0.049	-0.078	89.039	0.000
		7	-0.087	-0.198	93.698	0.000
		8	0.034	-0.156	94.425	0.000
		9	0.044	-0.060	95.647	0.000
		10	-0.009	-0.074	95.703	0.000
		11	0.040	-0.030	96.698	0.000
		12	-0.073	-0.083	99.994	0.000
		13	0.069	0.036	103.01	0.000
		14	-0.065	-0.043	105.69	0.000
		15	0.050	0.017	107.25	0.000
		16	-0.064	-0.044	109.80	0.000
		17	0.037	-0.000	110.66	0.000
		18	-0.031	-0.044	111.27	0.000
		19	0.010	-0.058	111.33	0.000
		20	0.040	0.006	112.37	0.000

Second differences of CPILFESL: Now the series looks stationary, hence it's a d(2), since the ACF cuts-off at lag 1, therefore it also has q = 1. Finally, the PACF shows a cut-off at lag 8, suggesting p = 8, even if this might lead to an overparametrization, so it should be tested the performance of the model also with lower values of p. In conclusion, without formal testing, it might be an ARIMA(8,2,1).



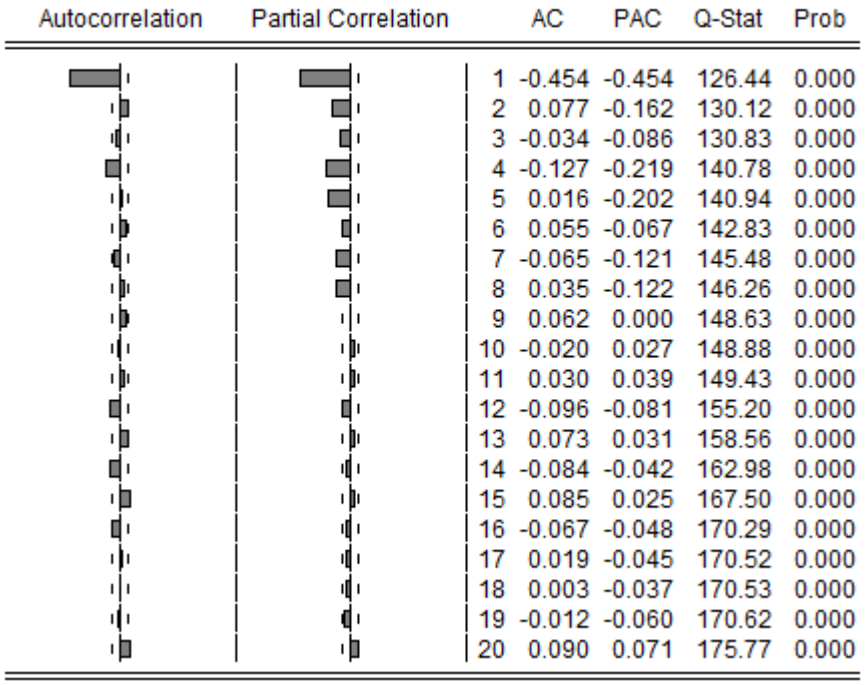
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.995	0.995	609.58	0.000
		2	0.990	-0.004	1213.7	0.000
		3	0.984	-0.002	1812.5	0.000
		4	0.979	-0.001	2405.9	0.000
		5	0.974	-0.005	2993.9	0.000
		6	0.969	-0.002	3576.6	0.000
		7	0.963	-0.004	4153.9	0.000
		8	0.958	-0.002	4725.9	0.000
		9	0.953	-0.003	5292.6	0.000
		10	0.948	-0.004	5853.9	0.000
		11	0.942	-0.004	6410.0	0.000
		12	0.937	-0.004	6960.7	0.000
		13	0.932	-0.004	7506.2	0.000
		14	0.926	-0.004	8046.3	0.000
		15	0.921	-0.006	8581.0	0.000
		16	0.916	-0.003	9110.4	0.000
		17	0.910	-0.003	9634.5	0.000
		18	0.905	-0.003	10153.	0.000
		19	0.899	-0.005	10667.	0.000
		20	0.894	-0.005	11175.	0.000

Log of CPILFESL: The ACF clearly indicates non-stationarity, hence a differentiation is needed.



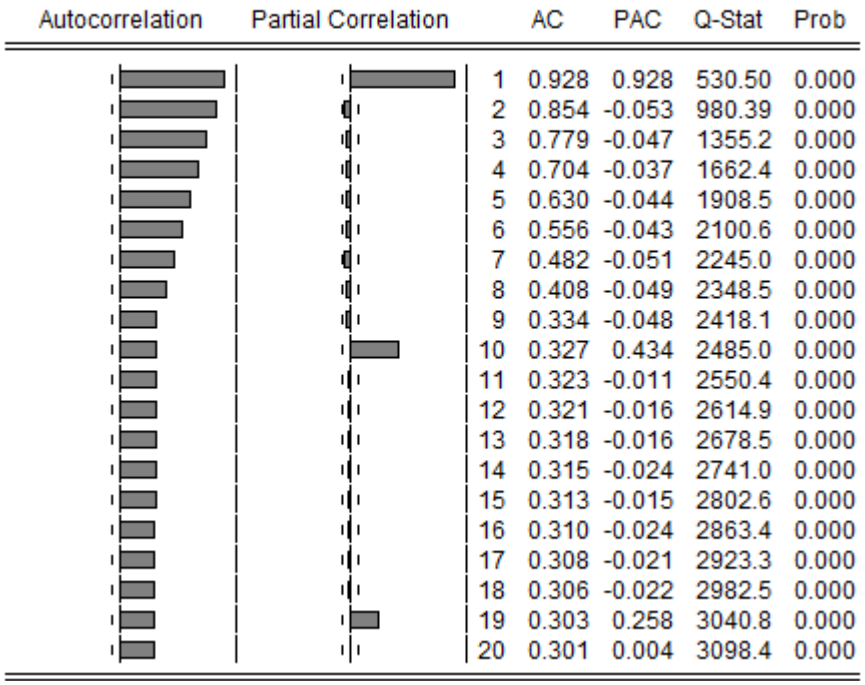
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.741	0.741	337.97	0.000
		2	0.716	0.369	653.40	0.000
		3	0.651	0.110	914.85	0.000
		4	0.605	0.048	1141.3	0.000
		5	0.623	0.186	1381.6	0.000
		6	0.636	0.185	1632.8	0.000
		7	0.622	0.060	1872.7	0.000
		8	0.637	0.108	2125.2	0.000
		9	0.632	0.101	2374.5	0.000
		10	0.592	-0.028	2593.4	0.000
		11	0.566	-0.043	2793.8	0.000
		12	0.529	-0.046	2969.0	0.000
		13	0.541	0.071	3152.5	0.000
		14	0.516	-0.039	3319.7	0.000
		15	0.532	0.031	3497.7	0.000
		16	0.504	-0.033	3658.1	0.000
		17	0.511	0.040	3823.0	0.000
		18	0.509	0.046	3987.0	0.000
		19	0.506	0.039	4149.0	0.000
		20	0.509	0.062	4313.7	0.000

First differences of log of CPILFESL: Also in this case the ACF has a very slow decay, suggesting that another differentiation is needed.



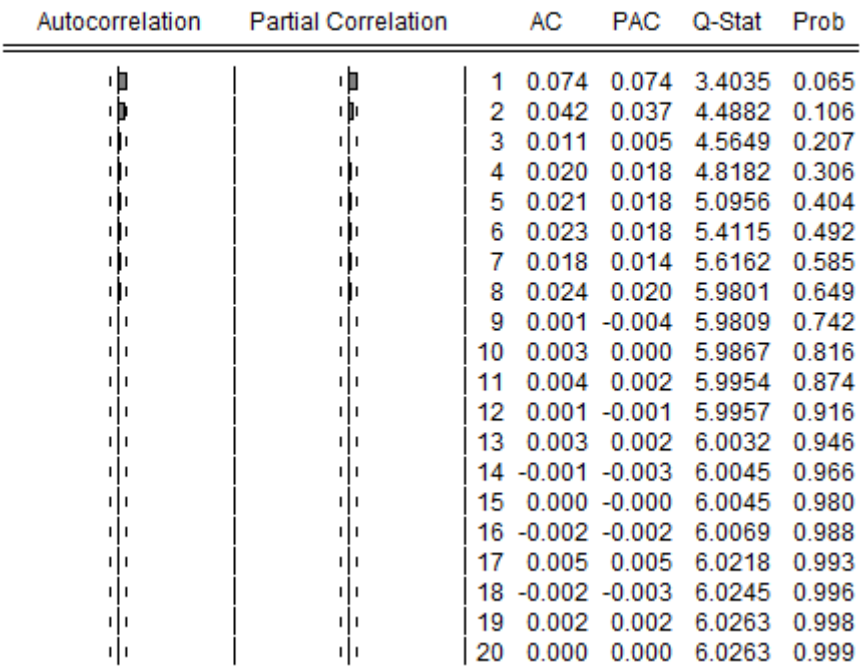
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.454	-0.454	126.44	0.000
		2	0.077	-0.162	130.12	0.000
		3	-0.034	-0.086	130.83	0.000
		4	-0.127	-0.219	140.78	0.000
		5	0.016	-0.202	140.94	0.000
		6	0.055	-0.067	142.83	0.000
		7	-0.065	-0.121	145.48	0.000
		8	0.035	-0.122	146.26	0.000
		9	0.062	0.000	148.63	0.000
		10	-0.020	0.027	148.88	0.000
		11	0.030	0.039	149.43	0.000
		12	-0.096	-0.081	155.20	0.000
		13	0.073	0.031	158.56	0.000
		14	-0.084	-0.042	162.98	0.000
		15	0.085	0.025	167.50	0.000
		16	-0.067	-0.048	170.29	0.000
		17	0.019	-0.045	170.52	0.000
		18	0.003	-0.037	170.53	0.000
		19	-0.012	-0.060	170.62	0.000
		20	0.090	0.071	175.77	0.000

Second differences of log of CPILFESL: Just like in the case of the original series in levels, with the second differences now there is stationarity, hence it's confirmed d(2). Again, the ACF cuts-off at lag 1 and the PACF seems to cut-off at lag 8, therefore without formal testing, it might be an ARIMA(8,1,1).



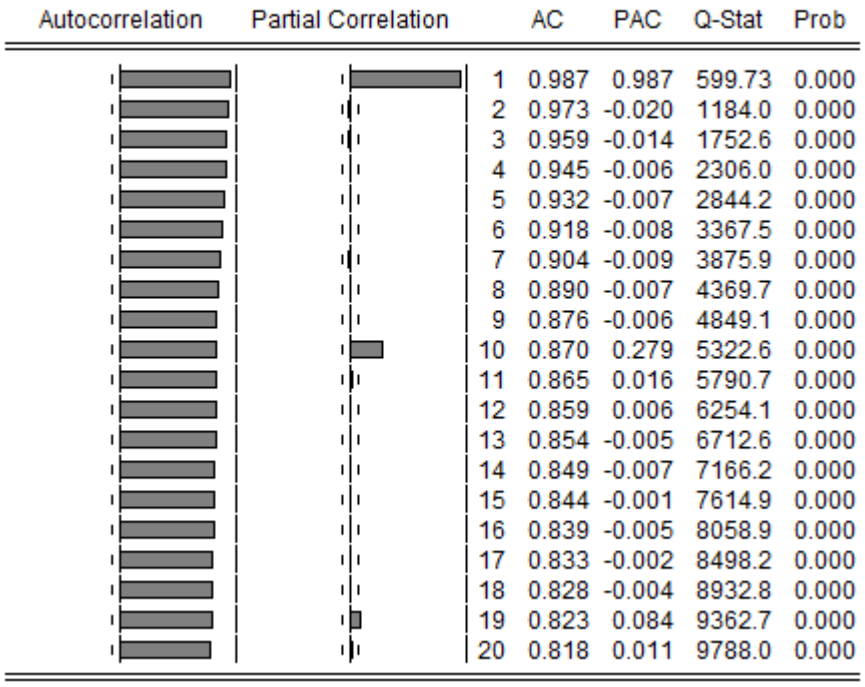
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.928	0.928	530.50	0.000
		2	0.854	-0.053	980.39	0.000
		3	0.779	-0.047	1355.2	0.000
		4	0.704	-0.037	1662.4	0.000
		5	0.630	-0.044	1908.5	0.000
		6	0.556	-0.043	2100.6	0.000
		7	0.482	-0.051	2245.0	0.000
		8	0.408	-0.049	2348.5	0.000
		9	0.334	-0.048	2418.1	0.000
		10	0.327	0.434	2485.0	0.000
		11	0.323	-0.011	2550.4	0.000
		12	0.321	-0.016	2614.9	0.000
		13	0.318	-0.016	2678.5	0.000
		14	0.315	-0.024	2741.0	0.000
		15	0.313	-0.015	2802.6	0.000
		16	0.310	-0.024	2863.4	0.000
		17	0.308	-0.021	2923.3	0.000
		18	0.306	-0.022	2982.5	0.000
		19	0.303	0.258	3040.8	0.000
		20	0.301	0.004	3098.4	0.000

M1SL in levels: The ACF presents a very slow decay, therefore it's non stationary.



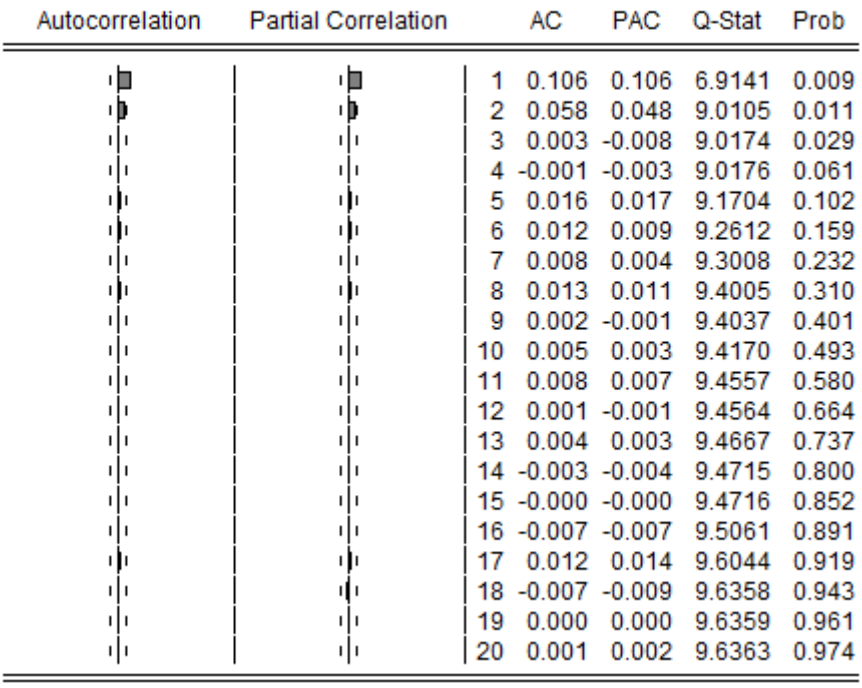
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.074	0.074	3.4035	0.065
		2	0.042	0.037	4.4882	0.106
		3	0.011	0.005	4.5649	0.207
		4	0.020	0.018	4.8182	0.306
		5	0.021	0.018	5.0956	0.404
		6	0.023	0.018	5.4115	0.492
		7	0.018	0.014	5.6162	0.585
		8	0.024	0.020	5.9801	0.649
		9	0.001	-0.004	5.9809	0.742
		10	0.003	0.000	5.9867	0.816
		11	0.004	0.002	5.9954	0.874
		12	0.001	-0.001	5.9957	0.916
		13	0.003	0.002	6.0032	0.946
		14	-0.001	-0.003	6.0045	0.966
		15	0.000	-0.000	6.0045	0.980
		16	-0.002	-0.002	6.0069	0.988
		17	0.005	0.005	6.0218	0.993
		18	-0.002	-0.003	6.0245	0.996
		19	0.002	0.002	6.0263	0.998
		20	0.000	0.000	6.0263	0.999

First difference of M1SL: Now the series looks stationary, hence it might be d(1). However, both the ACF and the PACF immediately cut-off at lag 1 but they're contained into the confidence interval at the zero (indeed Prob = 0,065 > 0,05), so they're significant only at a 10% level. This seems to lead to the unrealistic conclusion that both p and q are equal to zero, i.e. that the process is a white noise, so probably there have been an over-differentiation and the series is actually d(0). Formal tests are needed to establish the correct order of integration.



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.987	0.987	599.73	0.000
		2	0.973	-0.020	1184.0	0.000
		3	0.959	-0.014	1752.6	0.000
		4	0.945	-0.006	2306.0	0.000
		5	0.932	-0.007	2844.2	0.000
		6	0.918	-0.008	3367.5	0.000
		7	0.904	-0.009	3875.9	0.000
		8	0.890	-0.007	4369.7	0.000
		9	0.876	-0.006	4849.1	0.000
		10	0.870	0.279	5322.6	0.000
		11	0.865	0.016	5790.7	0.000
		12	0.859	0.006	6254.1	0.000
		13	0.854	-0.005	6712.6	0.000
		14	0.849	-0.007	7166.2	0.000
		15	0.844	-0.001	7614.9	0.000
		16	0.839	-0.005	8058.9	0.000
		17	0.833	-0.002	8498.2	0.000
		18	0.828	-0.004	8932.8	0.000
		19	0.823	0.084	9362.7	0.000
		20	0.818	0.011	9788.0	0.000

Log of M1SL: The ACF has a very slow decay, therefore the series is non-stationary and a differentiation is needed.



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.106	0.106	6.9141	0.009
		2	0.058	0.048	9.0105	0.011
		3	0.003	-0.008	9.0174	0.029
		4	-0.001	-0.003	9.0176	0.061
		5	0.016	0.017	9.1704	0.102
		6	0.012	0.009	9.2612	0.159
		7	0.008	0.004	9.3008	0.232
		8	0.013	0.011	9.4005	0.310
		9	0.002	-0.001	9.4037	0.401
		10	0.005	0.003	9.4170	0.493
		11	0.008	0.007	9.4557	0.580
		12	0.001	-0.001	9.4564	0.664
		13	0.004	0.003	9.4667	0.737
		14	-0.003	-0.004	9.4715	0.800
		15	-0.000	-0.000	9.4716	0.852
		16	-0.007	-0.007	9.5061	0.891
		17	0.012	0.014	9.6044	0.919
		18	-0.007	-0.009	9.6358	0.943
		19	0.000	0.000	9.6359	0.961
		20	0.001	0.002	9.6363	0.974

First difference of log of M1SL: Now the series is stationary, so it's d(1). Differently from the case in levels, now the values of ACF and PACF at lag 1 (where both cut-off) are statistically significant at a 5% level, so the series might be an ARIMA(1,1,1).